HIWIN MIKROSYSTEM

Application Note

E Series MECHATROLINK-III Drive Complete Setup with KEYENCE KV STUDIO

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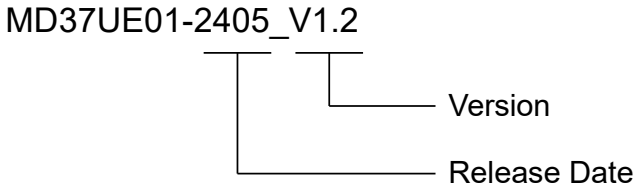
MD37UE01-2405_V1.2

Revision History

The version of the manual is also indicated on the bottom of the front cover.



Release Date	Version	Applicable Product	Revision Contents
May 20th, 2024	1.2	E Series MECHATROLINK-III Drive	Support E series drives. Modify the term of E1 to E series.
Oct. 18th, 2023	1.1	E1 MECHATROLINK-III Drive	1. Update section 3.1 **Positioning control**. 2. Update section 4.3 **Origin sensor and Z-phase**.
Jun. 30th, 2023	1.0	E1 MECHATROLINK-III Drive	First edition.

Related Documents

Through related documents, users can quickly understand the positioning of this manual and the correlation between manuals and products. Go to HIWIN MIKROSYSTEM's official website → Download → Manual Overview for details (https://www.hiwinmikro.tw/Downloads/ManualOverview_EN.htm).

Preface

This manual provides detailed information on the operation of PLC software KV STUDIO when E series MECHATROLINK-III drive is used with KEYENCE KV-7000 series PLC.

Specifications of Software/Hardware

Name	Version of Software/Firmware
E Series MECHATROLINK-III Drive	Software (Thunder): 1.9.16.0 or above Firmware: 2.8.16
KEYENCE KV-7500	Software (KV STUDIO): 11.61 or above Firmware: 2.400 or above
KEYENCE KV-XH04ML	Firmware: 1.106 or above

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1. Communication and module setup

1.1 Introduction of hardware device

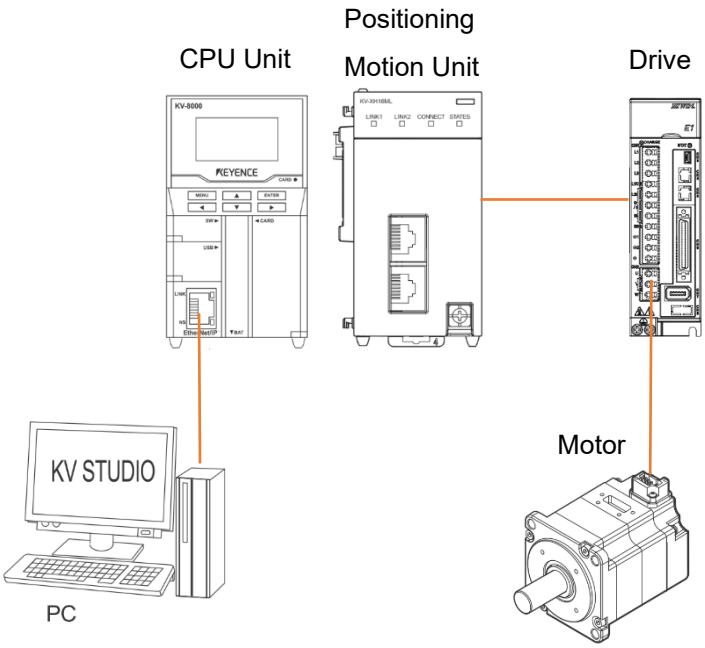

Figure 1.1.1

KEYENCE KV-7500 is a controller composed of a CPU unit and one or more positioning motion units. For the first use, users need to combine CPU unit and positioning motion unit and prepare a 24 VDC 1.8 A power supply for CPU unit. CPU unit is mainly used to connect with the computer, and positioning motion unit is mainly used to connect with the drive.

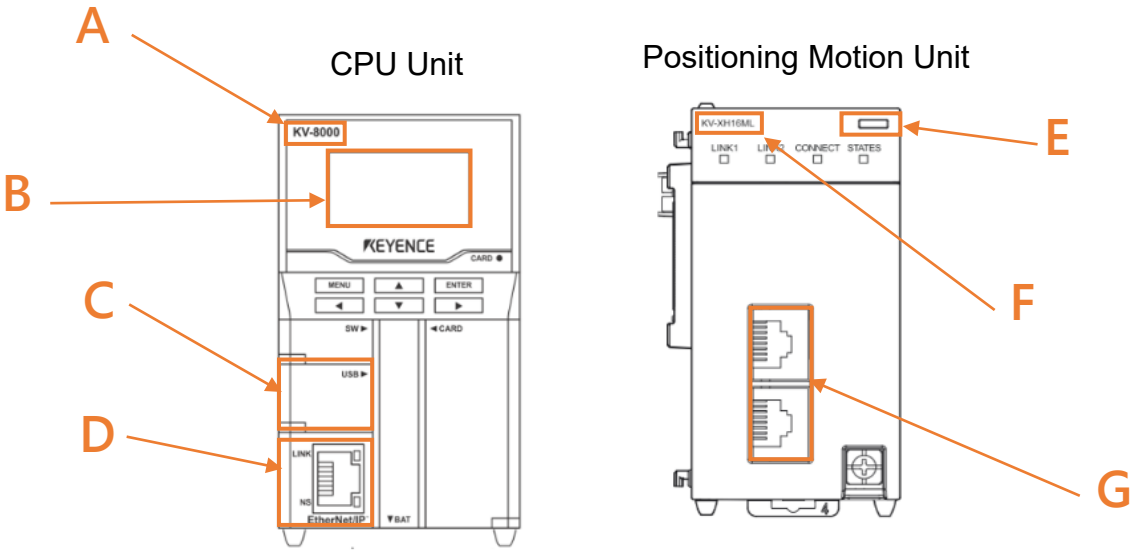

Figure 1.1.2

- **Field A**

  Model of CPU unit.

- **Field B**

  LCD screen display.

- **Field C**

  Computer USB port.

- **Field D**

  CPU unit network port.

- **Field E**

  LED display lights.
  Red light: Unit connection failure.
  Green light: Successful unit connection.

- **Field F**

  Model of positioning motion unit.

- **Field G**

  Motion unit network port.
  Users need to adopt Keyence's special network cable for motion unit and drive; ordinary network cables may not be able to communicate successfully.

1.2 IP setting and connection

1. For first-time setup, connect USB cable and network cable to CPU unit and the computer, and open KV STUDIO software interface.

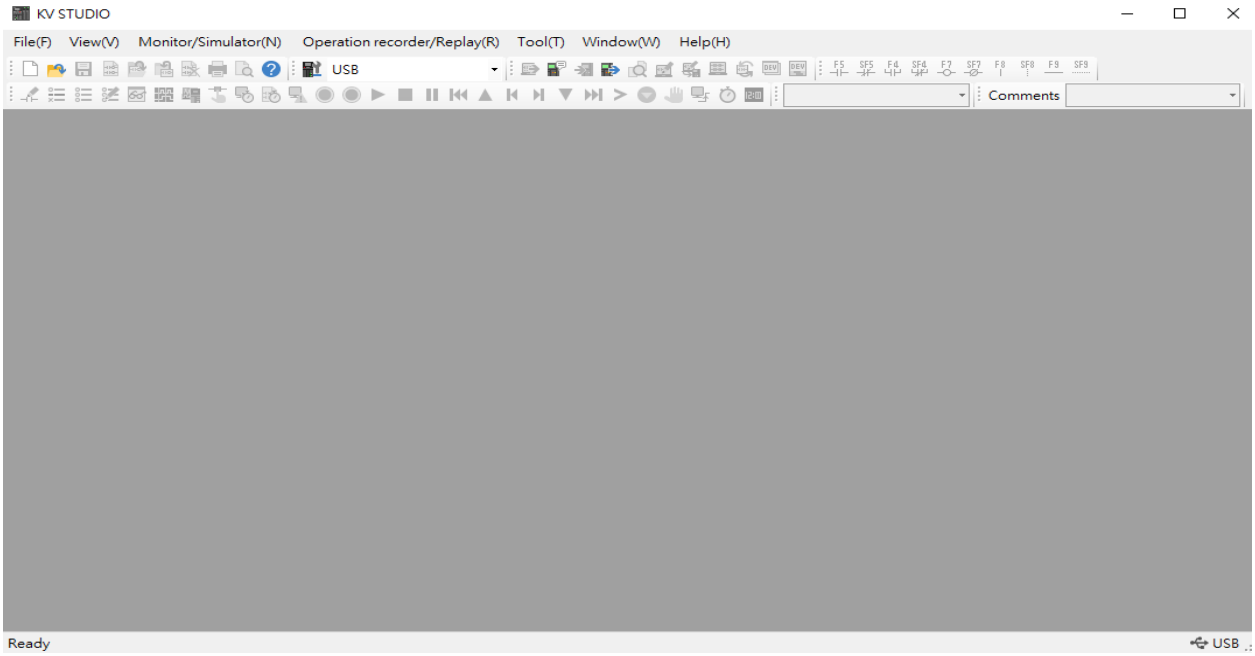

Figure 1.2.1

2. Create a new project.
   (In this step, press **NO** in "Confirm unit setting information" to prevent automatic generation of unit configuration, which will be set in step 6.)

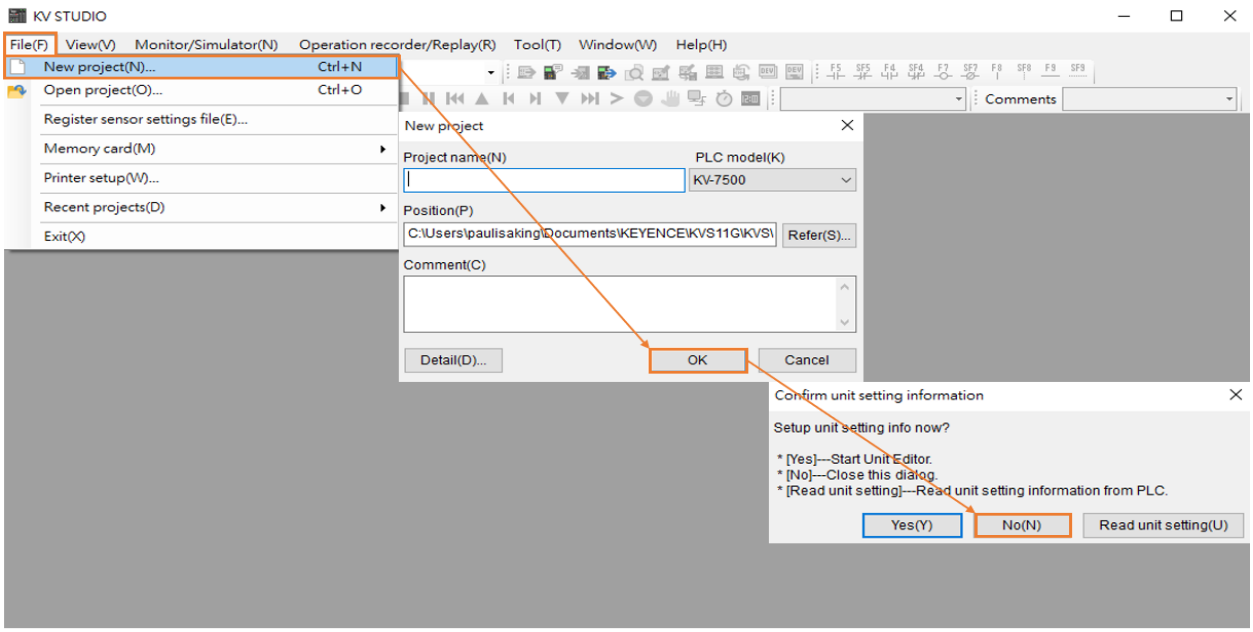

Figure 1.2.2

3. Set IP address to 192.168.0.100, which is in the same network domain as the controller.

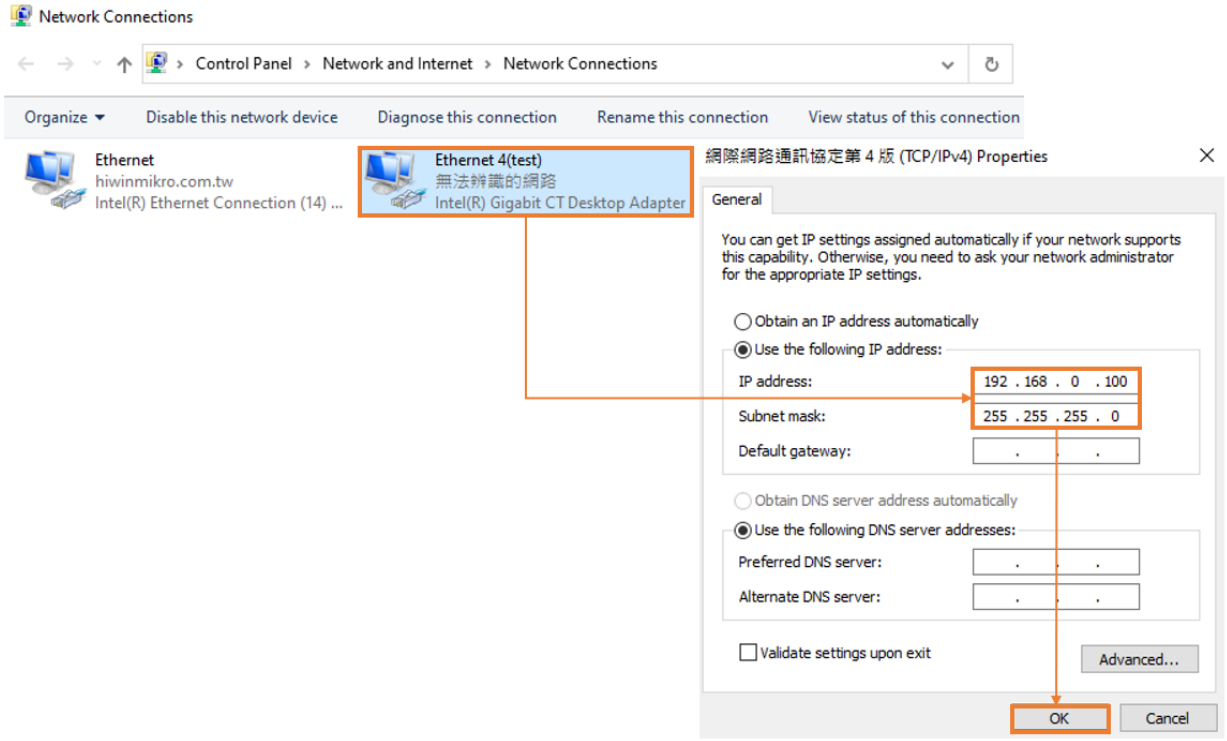

Figure 1.2.3

4. Switch KV STUDIO mode to **Editor**, so that the subsequent operations could be carried out.

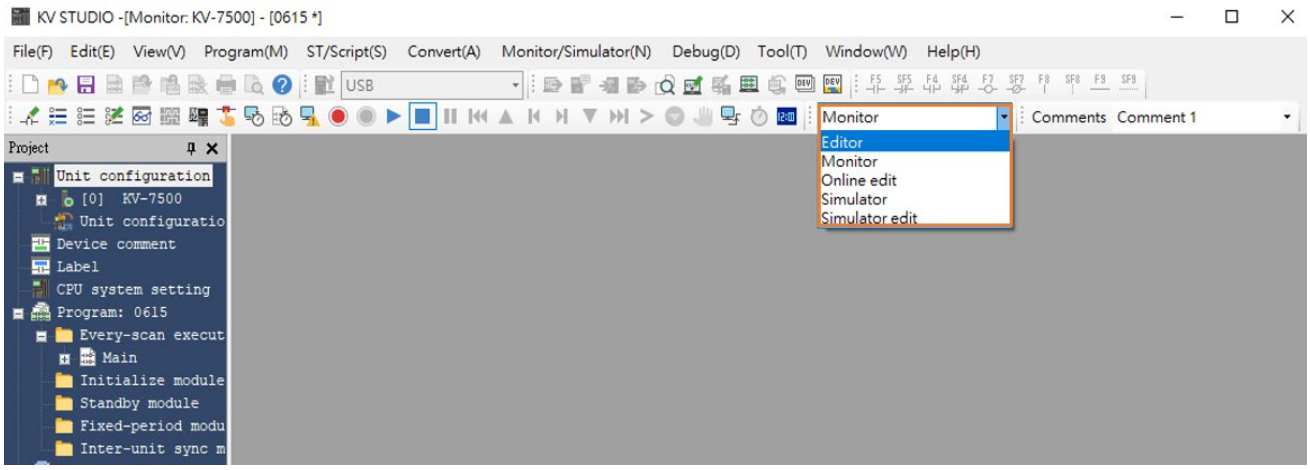

Figure 1.2.4

5. Select **USB** as communication path.

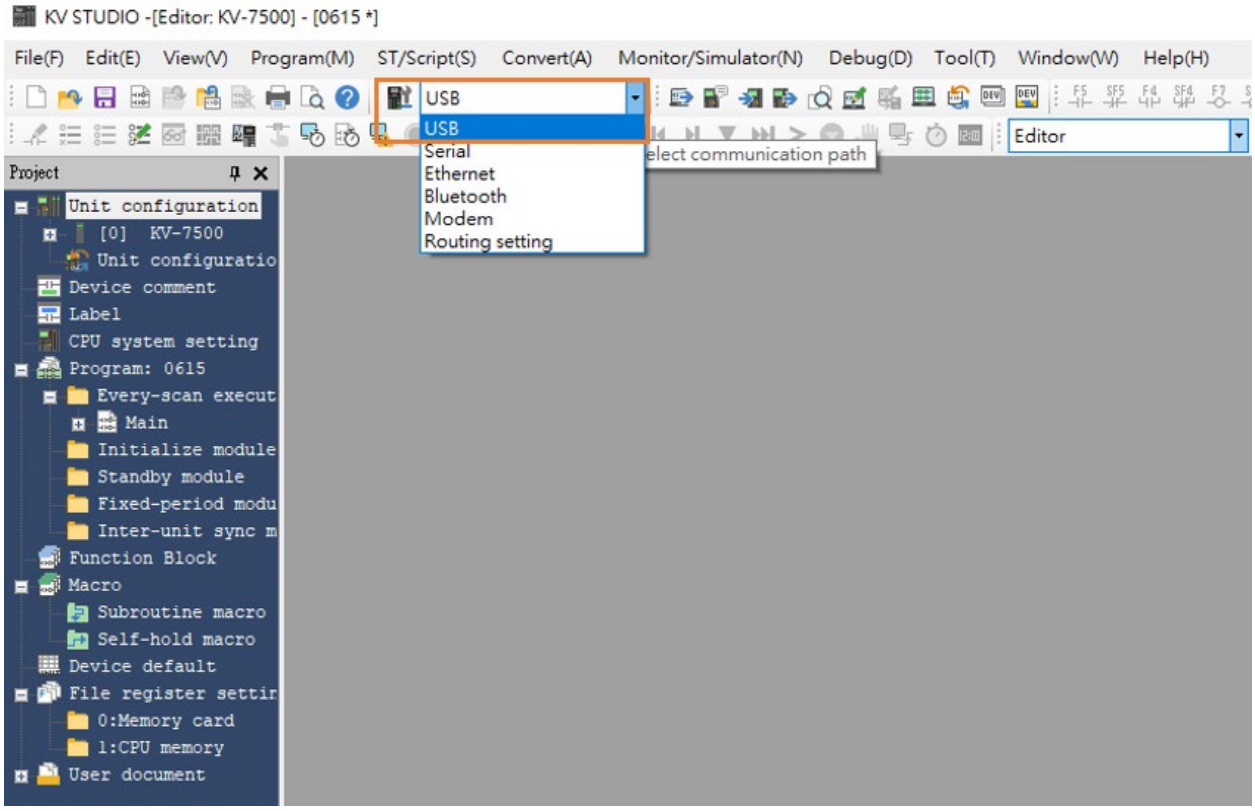

Figure 1.2.5

6. Click **Unit configuration** on the upper left side, and then right-click to select **Unit Editor**.

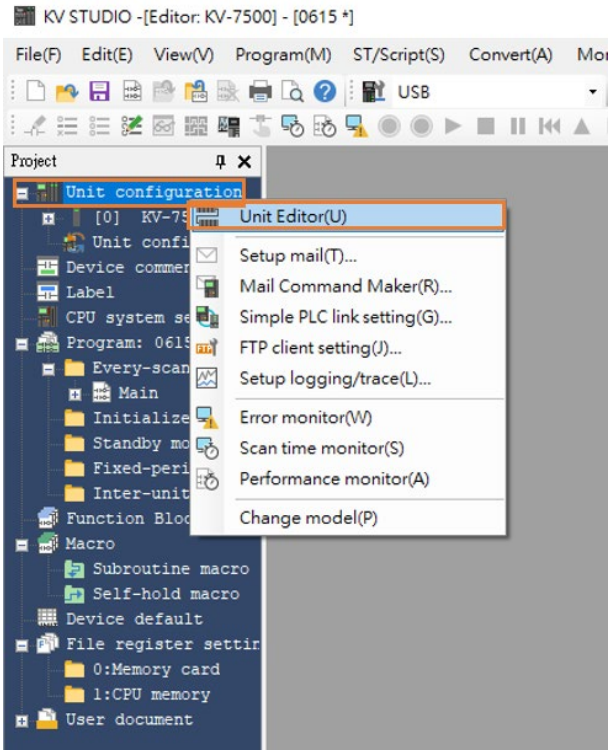

Figure 1.2.6

7. Click "Acquire the configuration information of the unit connected to the PLC" and press **Yes** to read the existing positioning motion unit model of the user.

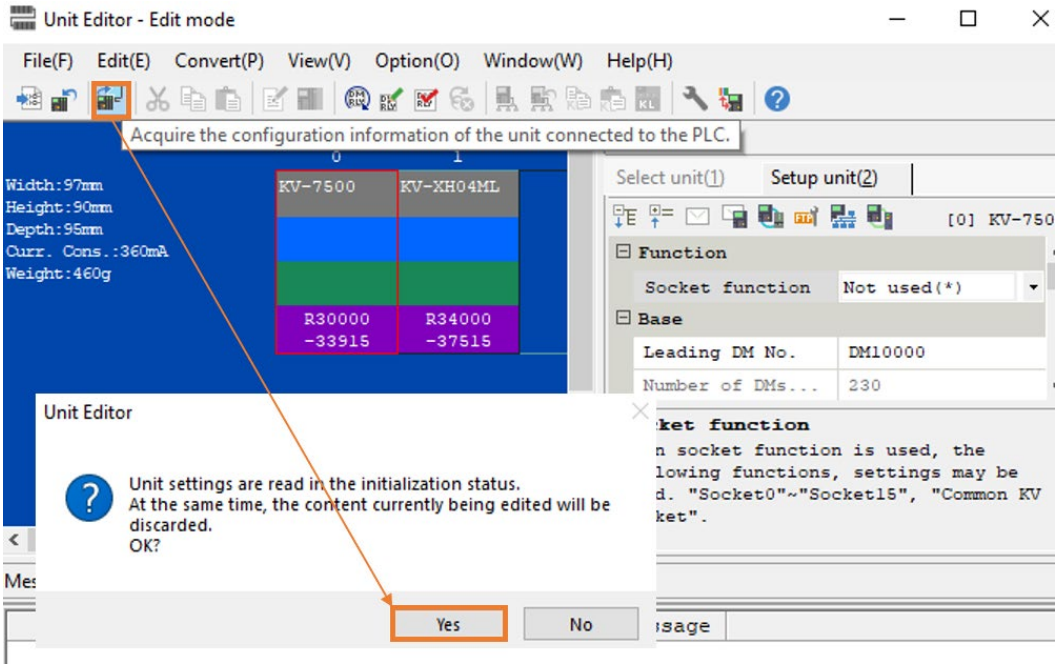

Figure 1.2.7

8. When the models of CPU unit and positioning motion unit appear, click **OK** on the lower right side.

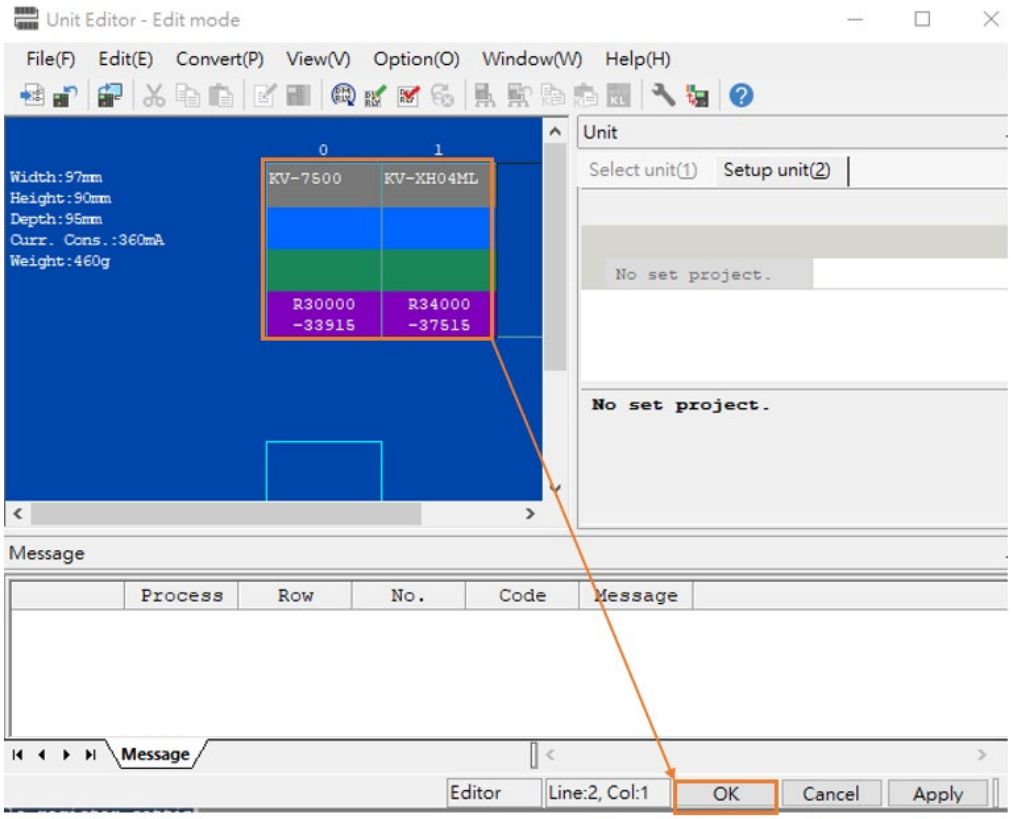

Figure 1.2.8

9. Check if the model under **Unit configuration** is consistent with the model of actual controller.

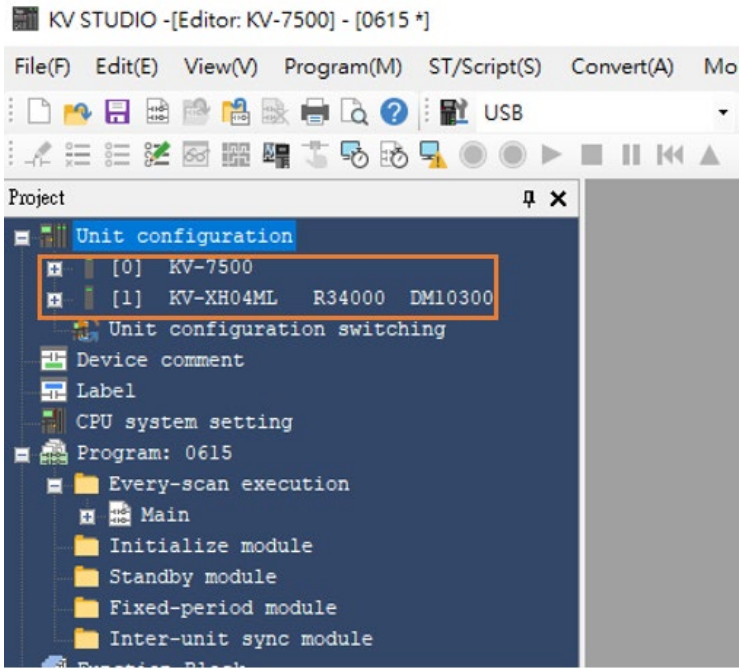

Figure 1.2.9

10. Check if the communication path is **USB**, and press **PLC Transfer** > **Execute**. At this time, the display light on the upper right side of the positioning motion unit will turn from red to green (refer to **Field E** in Figure 1.1.2), representing successful setup of CPU unit and positioning motion unit.

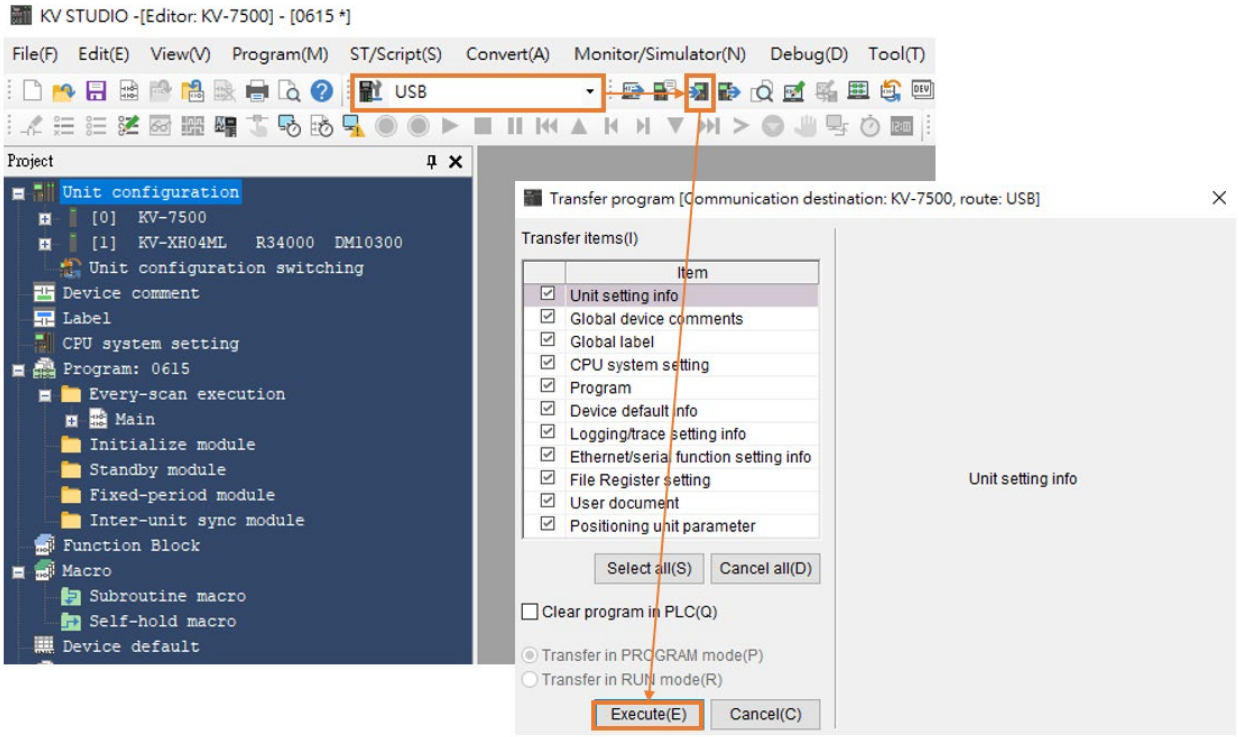

Figure 1.2.10

11. After completing unit editor settings, select **Serial** as communication path and click **Comm settings** > **Ethernet** > **Search destination**.

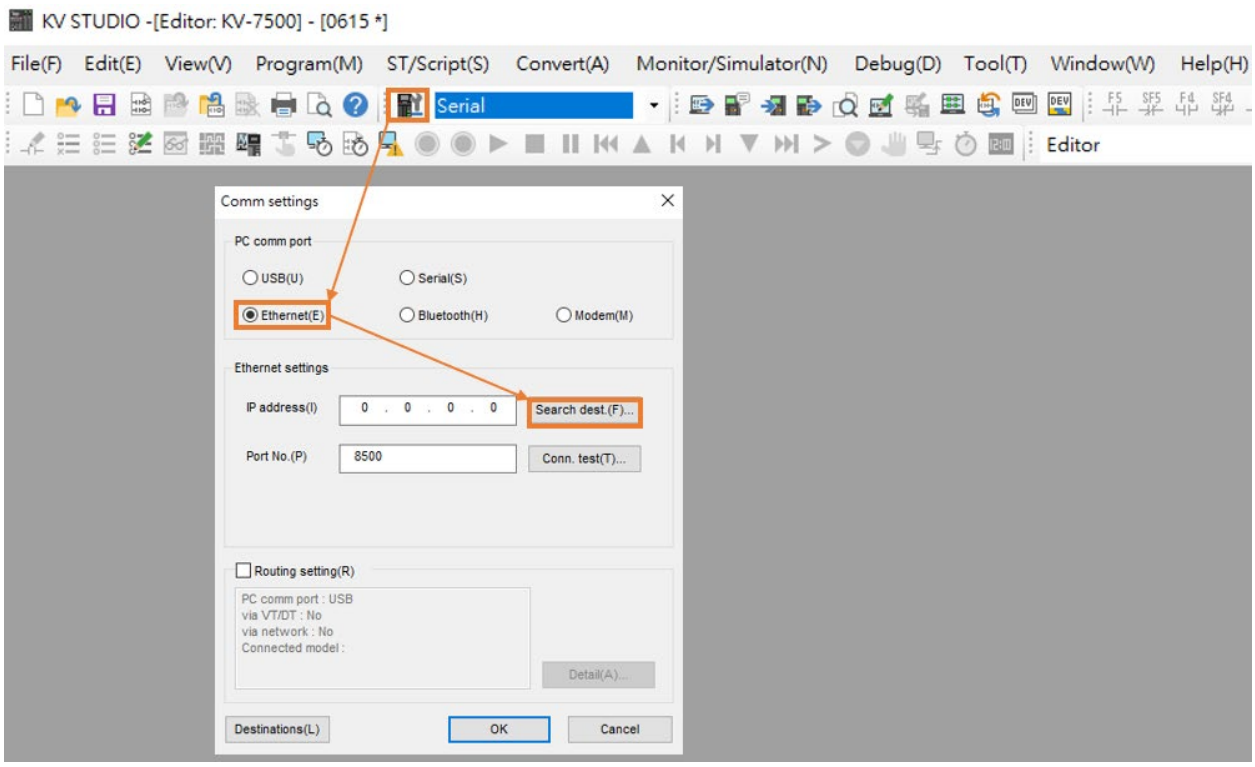

Figure 1.2.11

12. Click the network card that is connected to CPU unit and then click on **Execute**.

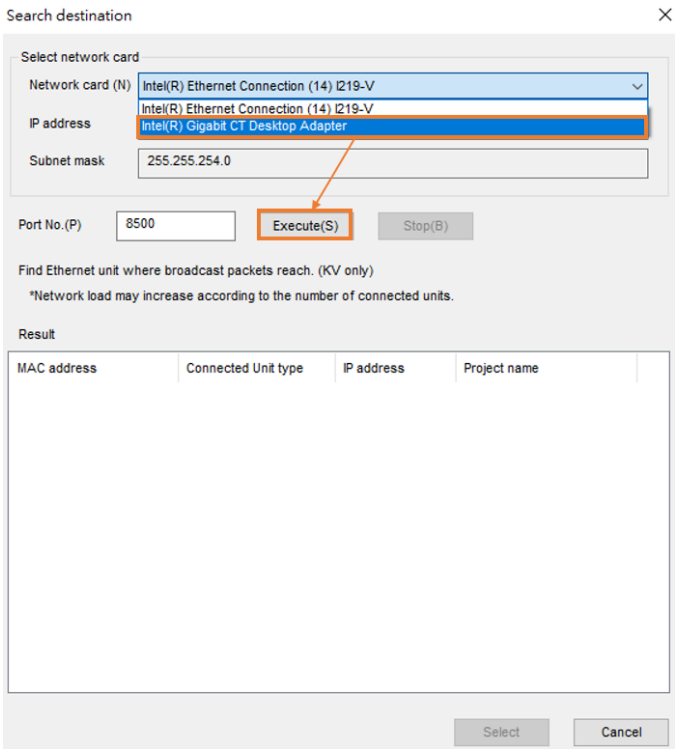

Figure 1.2.12

13. After pressing **Execute** for a few seconds, the results will be displayed below. Select the connected unit type and click **Select**.

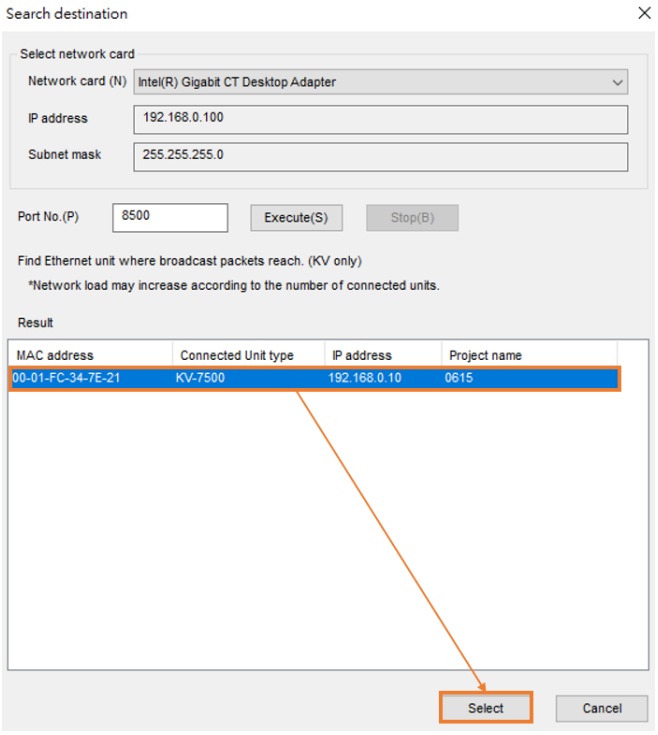

Figure 1.2.13

14. Click **OK** to complete the connection.

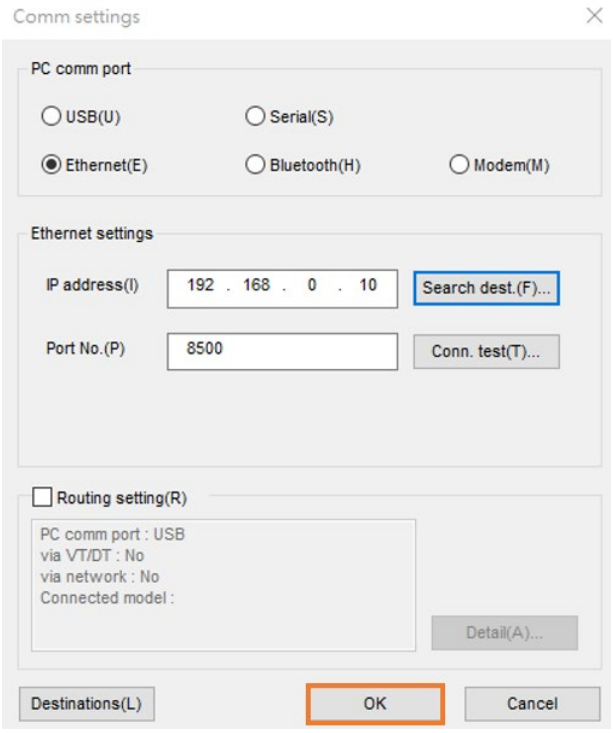

Figure 1.2.14

15. Switch KV STUDIO mode to **Monitor**, and check if the motion unit models are turned to green lights, indicating the connection between PC and CPU unit is established.

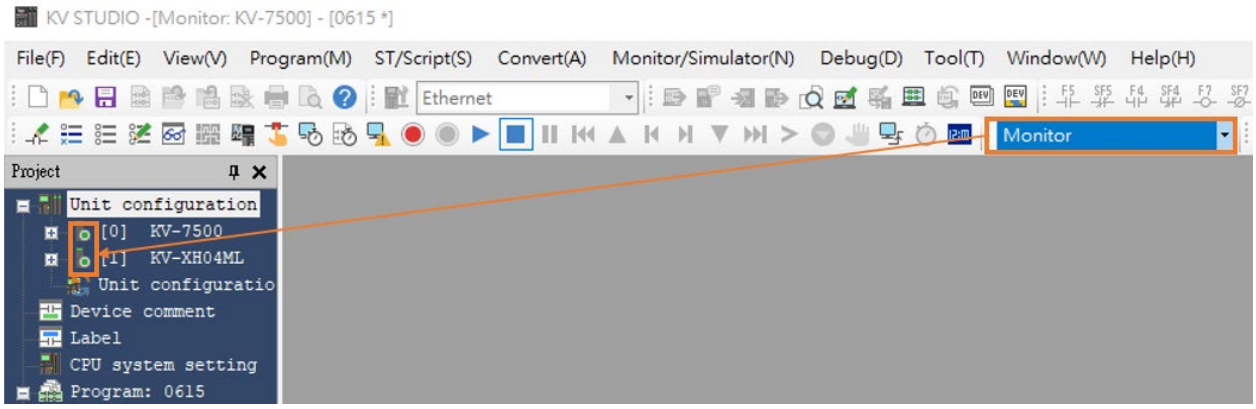

Figure 1.2.15

16. Check if the communication type of the drive is MECHATROLINK-III and is set to “Drive ready” state (For detailed setting operation, please refer to "E Series Servo Drive Thunder Software Operation Manual"). Set Access to **Controller** so that the positioning motion unit of Keyence controller can be connected to the drive.

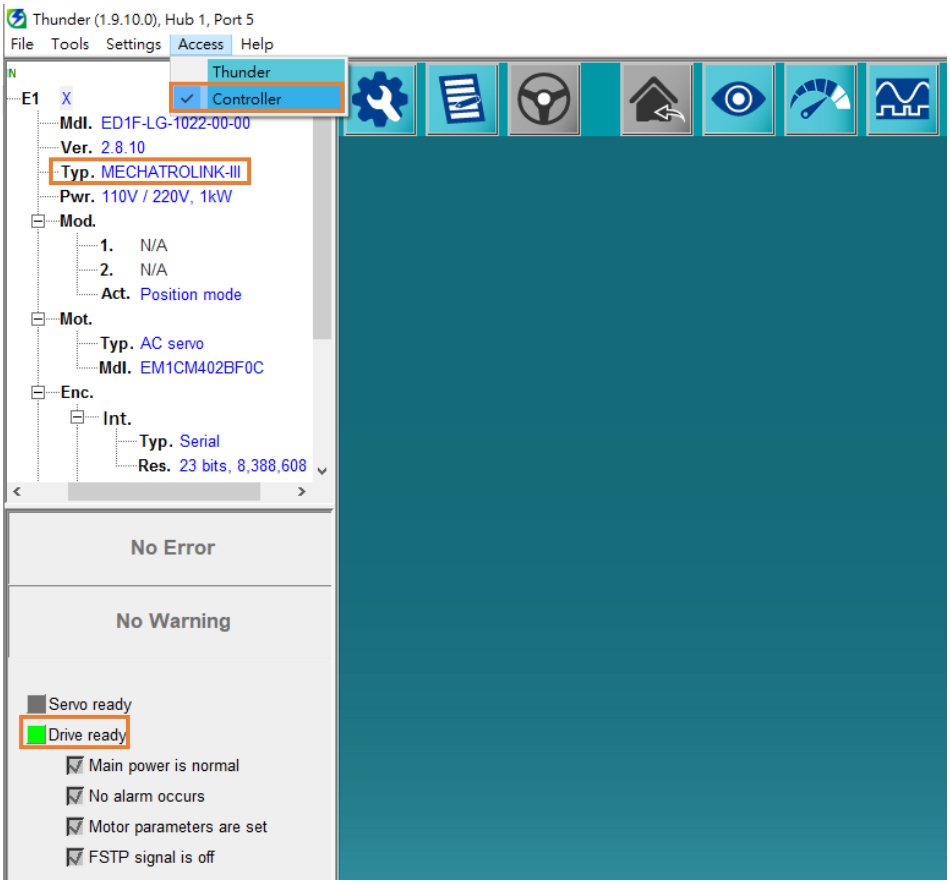

Figure 1.2.16

1.3 Axis configuration

1. Switch KV STUDIO mode to **Editor**. Click the positioning motion unit which will be connected to the drive and open **Axis configuration setting**.

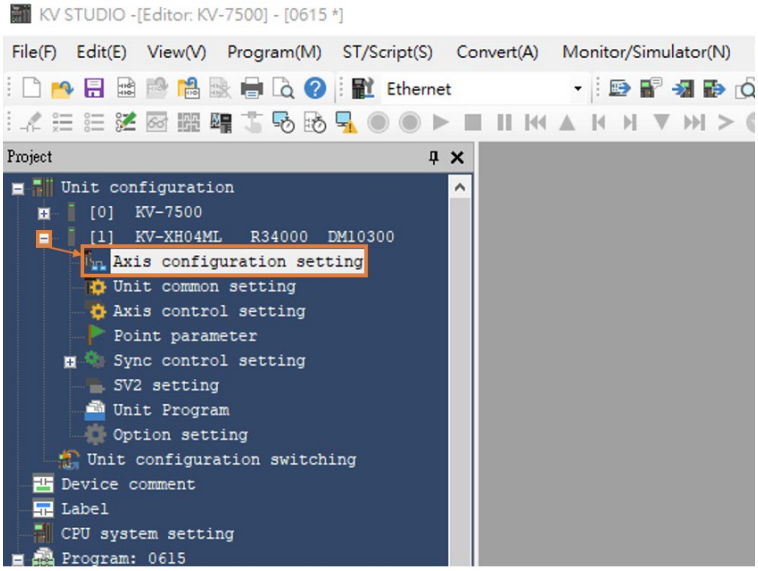

Figure 1.3.1

2. At this time, the following screen will appear. Double-clicking **Servo** on the right, and the icon of a servo motor will appear on the left. Please enter the relevant information of the drive on the lower right side.

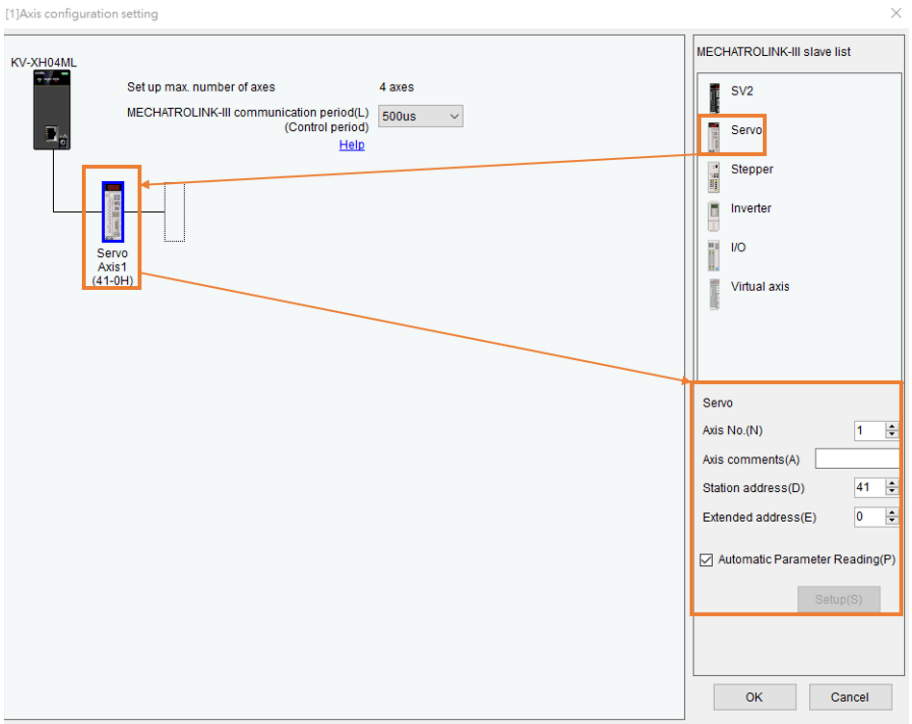

Figure 1.3.2

3. Open the cover of drive panel and observe SW1 and SW2. The arrow direction of knob indicates the station address of the drive, SW1 refers to tens digit, and SW2 refers to units digit. However, some station addresses are not supported by the drive, as shown in the table in Figure 1.3.4. If SW1=0, the value of SW2 cannot be a number from 0 to 2; if SW1=F, the value of SW2 cannot be a number from 0 to F. If the station address of the drive is the above number, please turn the knobs of SW1 and SW2 to avoid the above range and restart the power. Finally, enter the station address of the drive to **Station address** shown in Figure 1.3.4.

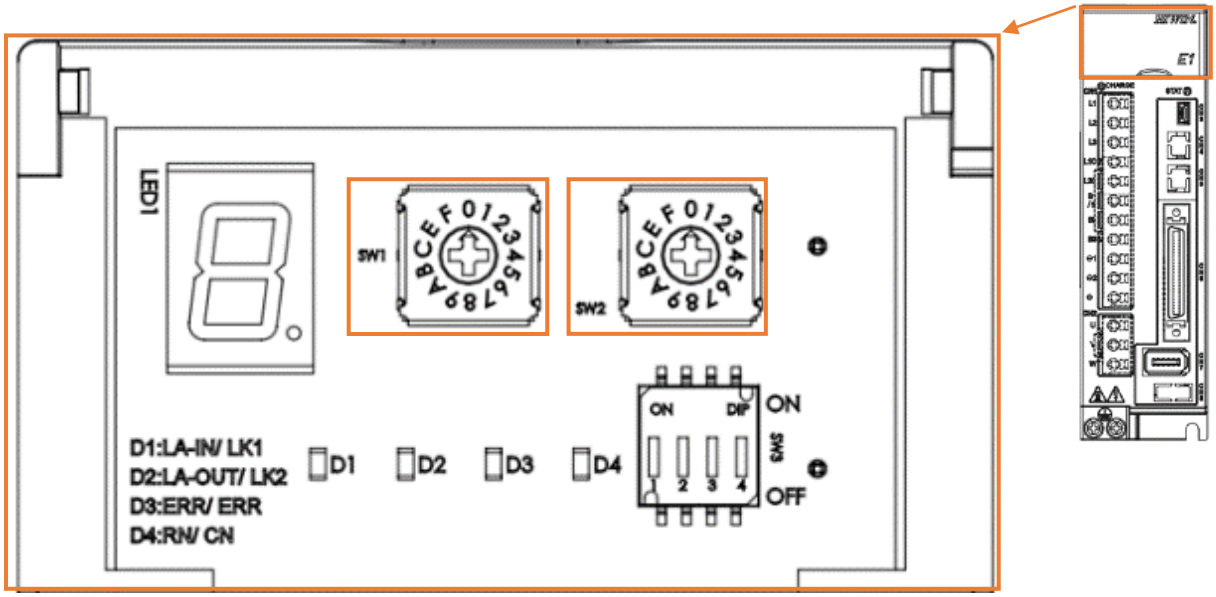

Figure 1.3.3

SW1	SW2	Station Address
0	0 to 2	Reserved
0	3	03h
⋮	⋮	⋮
E	F	EFh
F	0 to F	Reserved

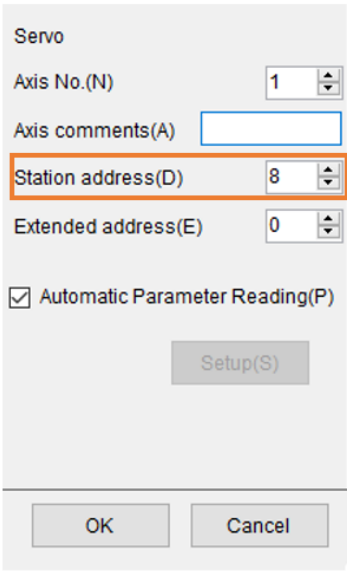

Figure 1.3.4

Note:

If the drive is set to gantry, the slave's SW2 needs to be set to 8, otherwise it may cause gantry communication errors.

4. After completing station address setting, do not set up coordinate transformation at this time, which will be set after coordinate unit in chapter 2.

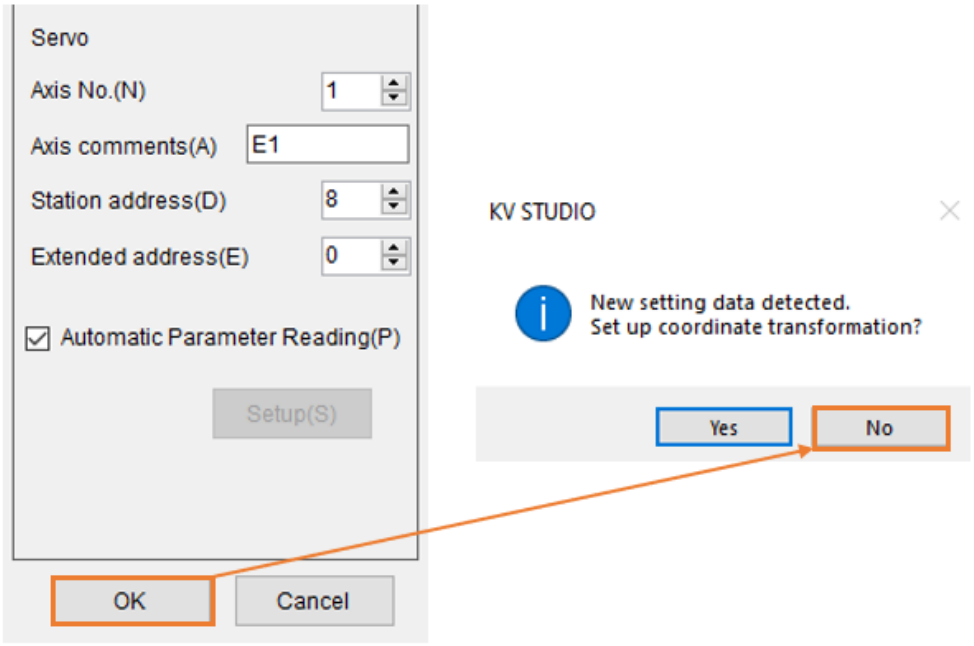

Figure 1.3.5

5. Click **PLC Transfer** to import the existing setting values into the controller.

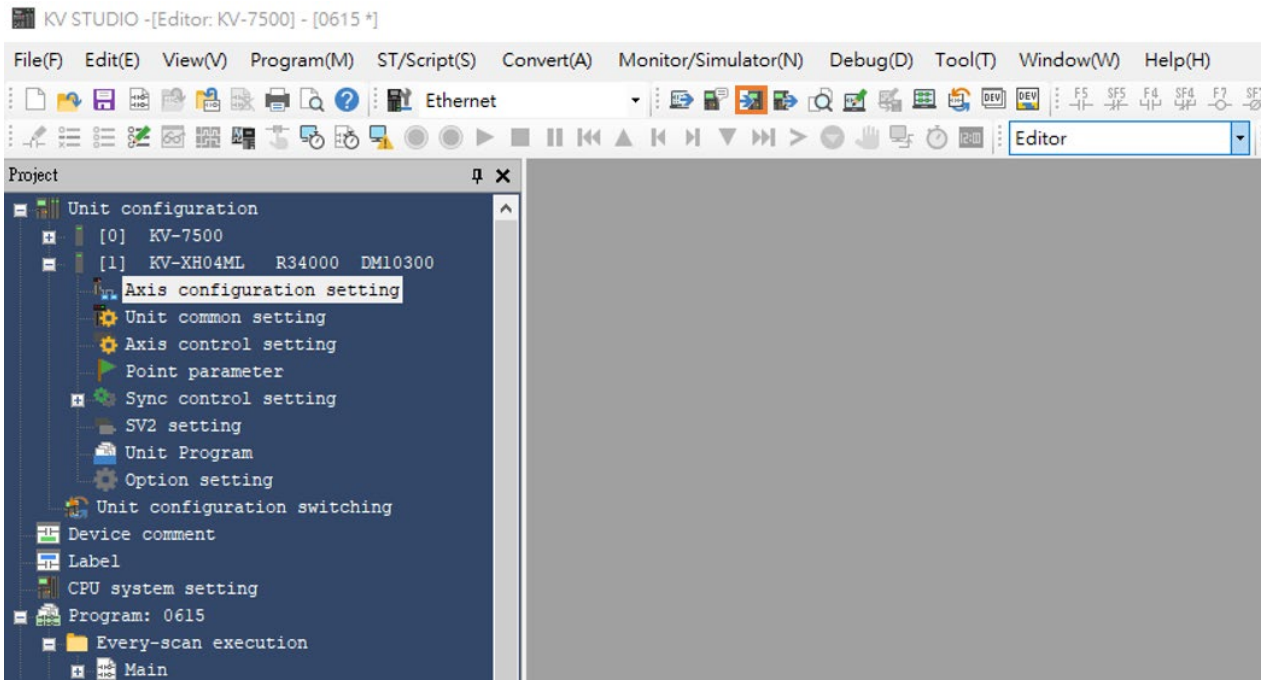

Figure 1.3.6

6. Press **Execute**.

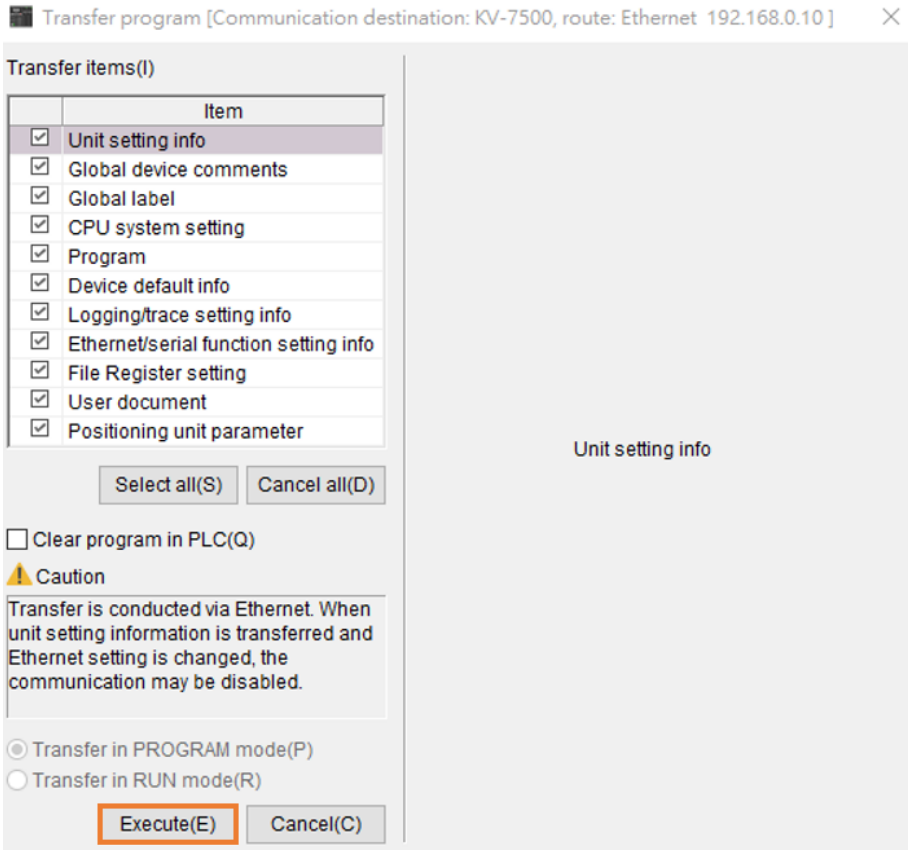

Figure 1.3.7

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2. Parameters setup

1. Click **Axis control setting** and set unit of coordinate and place of decimal point. Then, click coordinate transformation at the top.

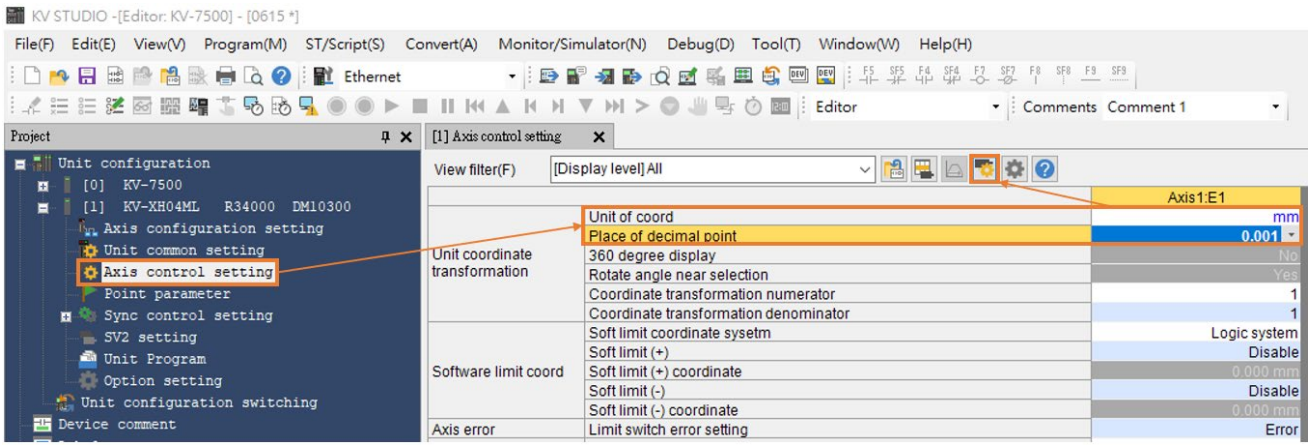

Figure 2.1

2. After setting the relevant parameters, click **Advanced setting** to complete the setting of encoder resolution and servo electronic gear ratio.
   The settings in Figure 2.1 and Figure 2.2 take resolution of 8388608 pulse/rev for one motor revolution (1mm) and 1:1 electronic gear ratio as an example.

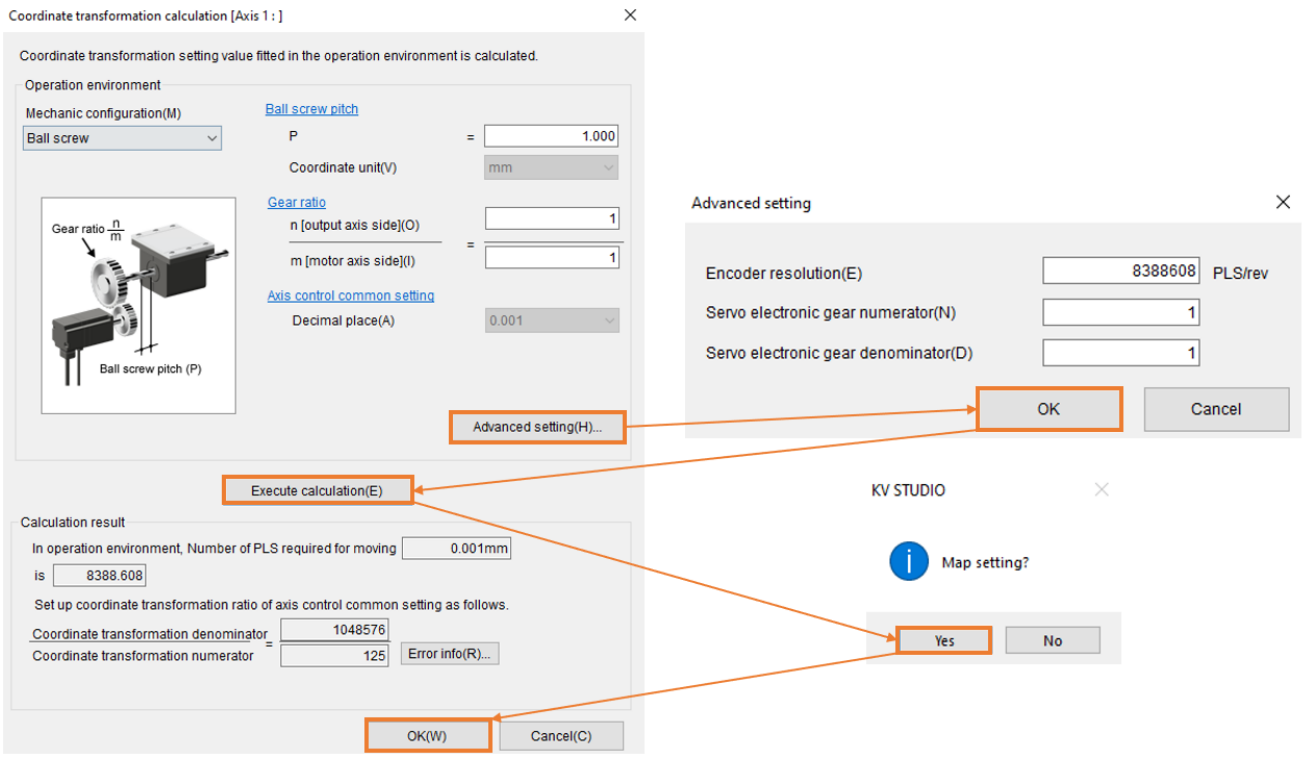

Figure 2.2

3. Turn on **Axis control setting** and complete parameter settings in operating speed, JOG, and origin return. **Absolute position detection system** is set according to the encoder: incremental type is set to INC; absolute type is set to ABS.

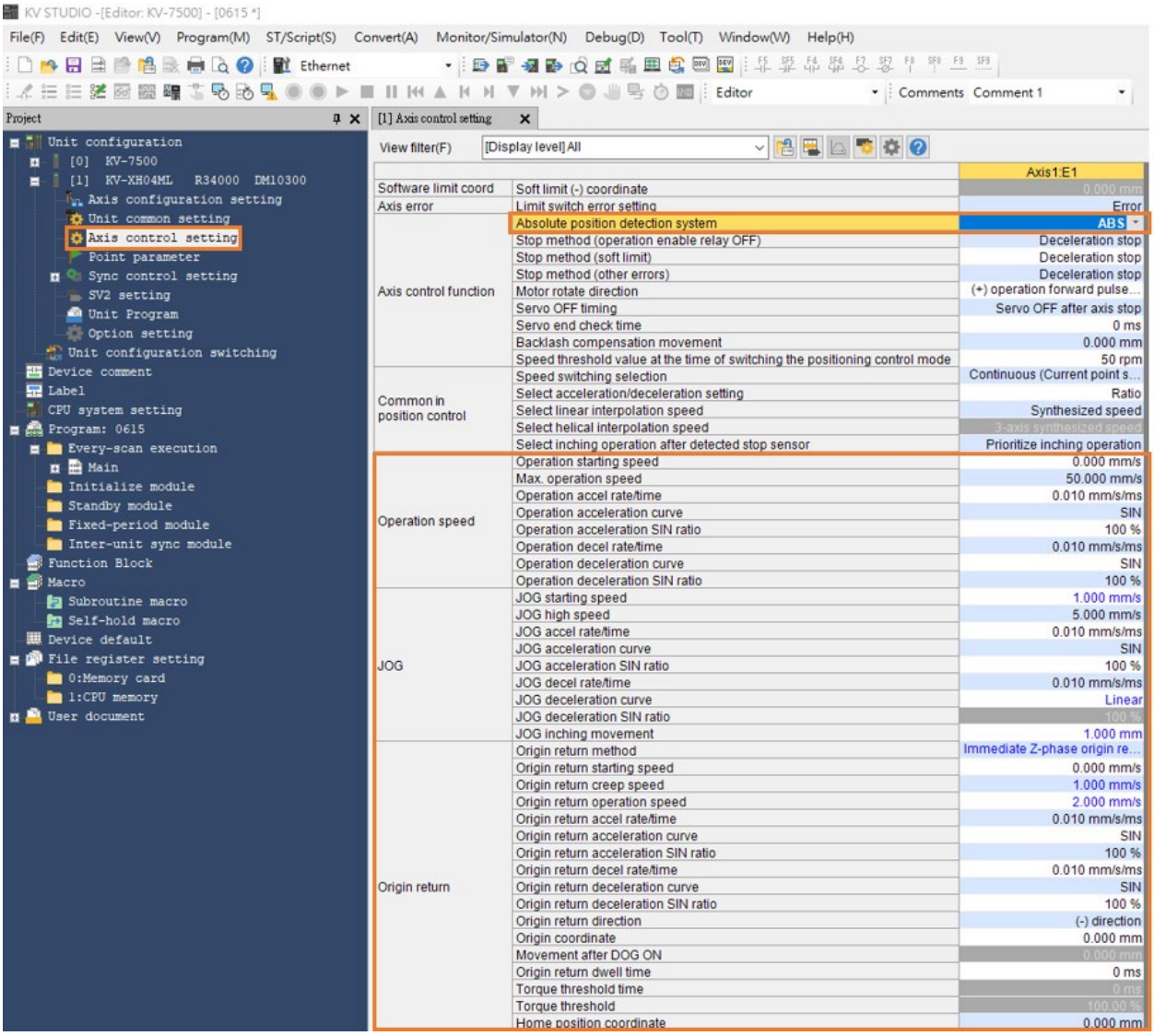

Figure 2.3

Note:

The highest operation speed must be equal to the rated operation speed of the motor. The setting of origin return, JOG, operating starting speed, high speed, acceleration and deceleration rate/time, and acceleration curve are based on the same concept, which will be describe in detail in chapter 3. The unit of 1 mm/s here indicates that the motor speed is 1 rev/s (60 rpm).

4. After the parameters are set, click **PLC Transfer** and switch KV STUDIO mode to **Monitor**.

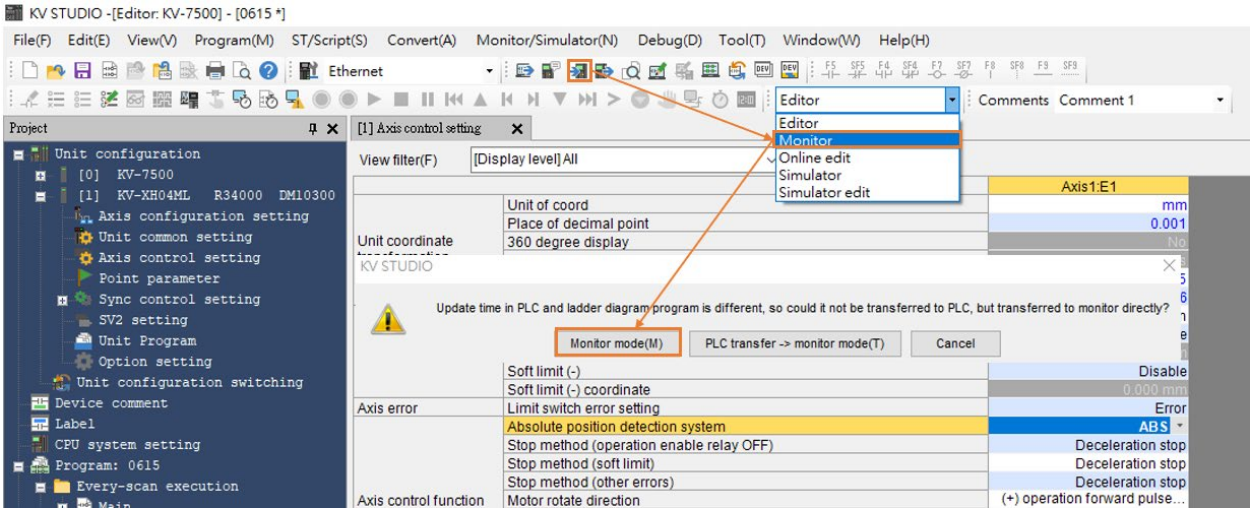

Figure 2.4

5. To save this project, switch KV STUDIO mode to **Editor**, and click **File** > **Save project** or **Save project as** and set project name and position to complete the archive.

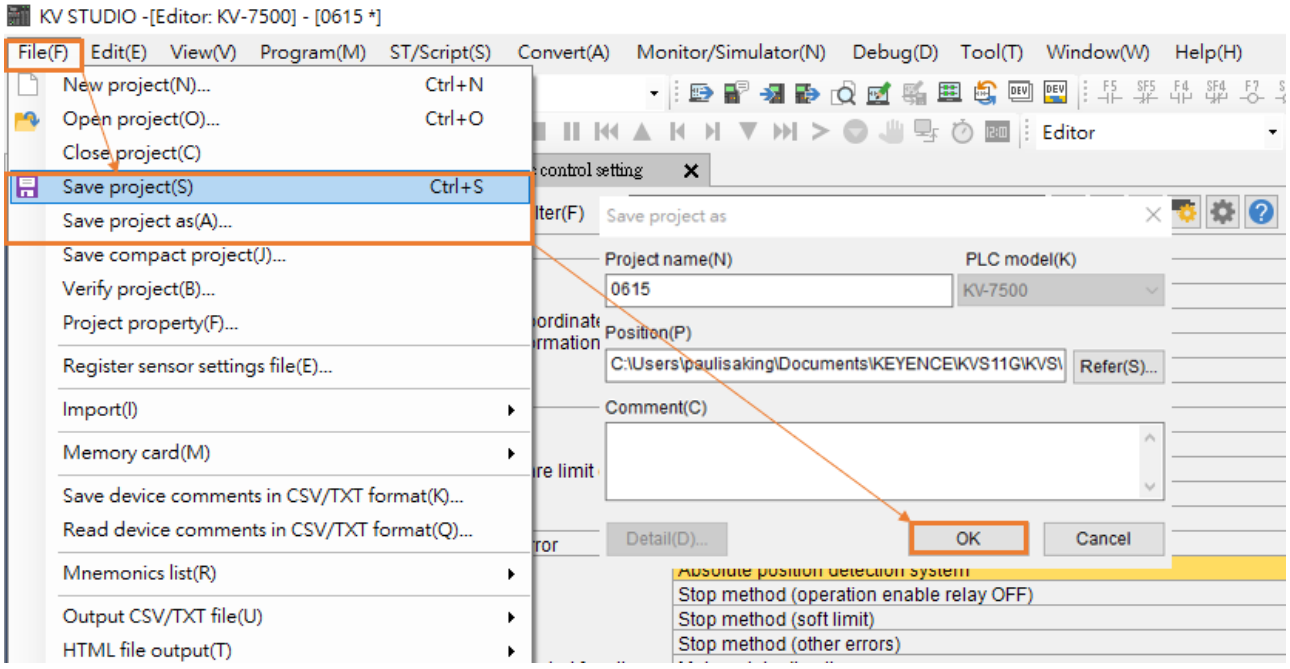

Figure 2.5

Supplementary note:

If users use KV STUDIO for the second time and would like to adopt the previous project, please click **File** > **Open project** and select the previously set project or click the area in orange boxes in Figure 2.7 to read the previous PLC project.

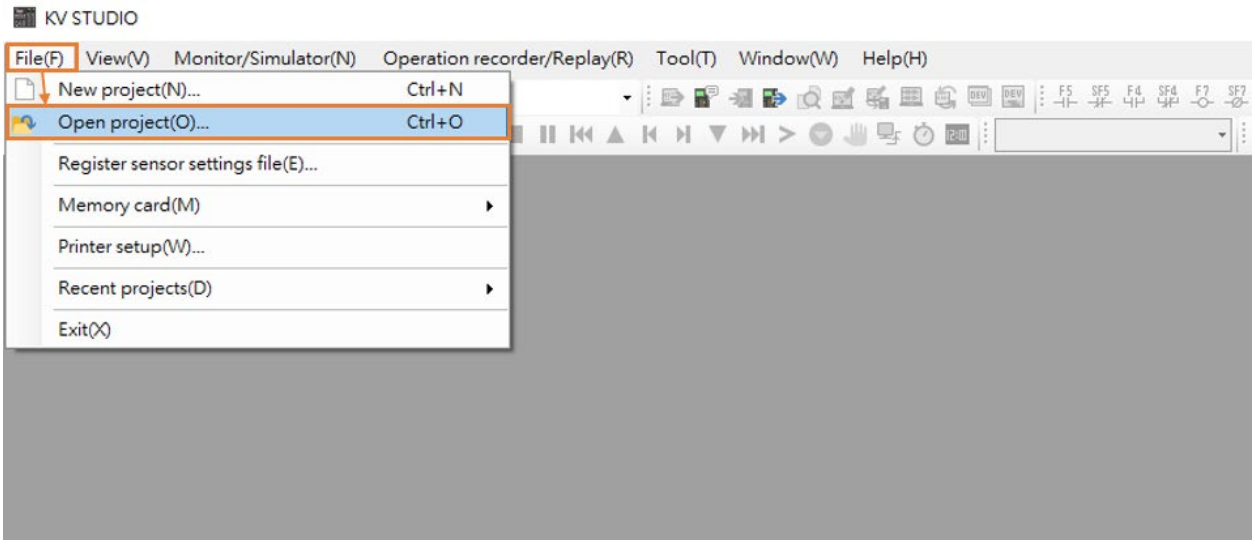

Figure 2.6

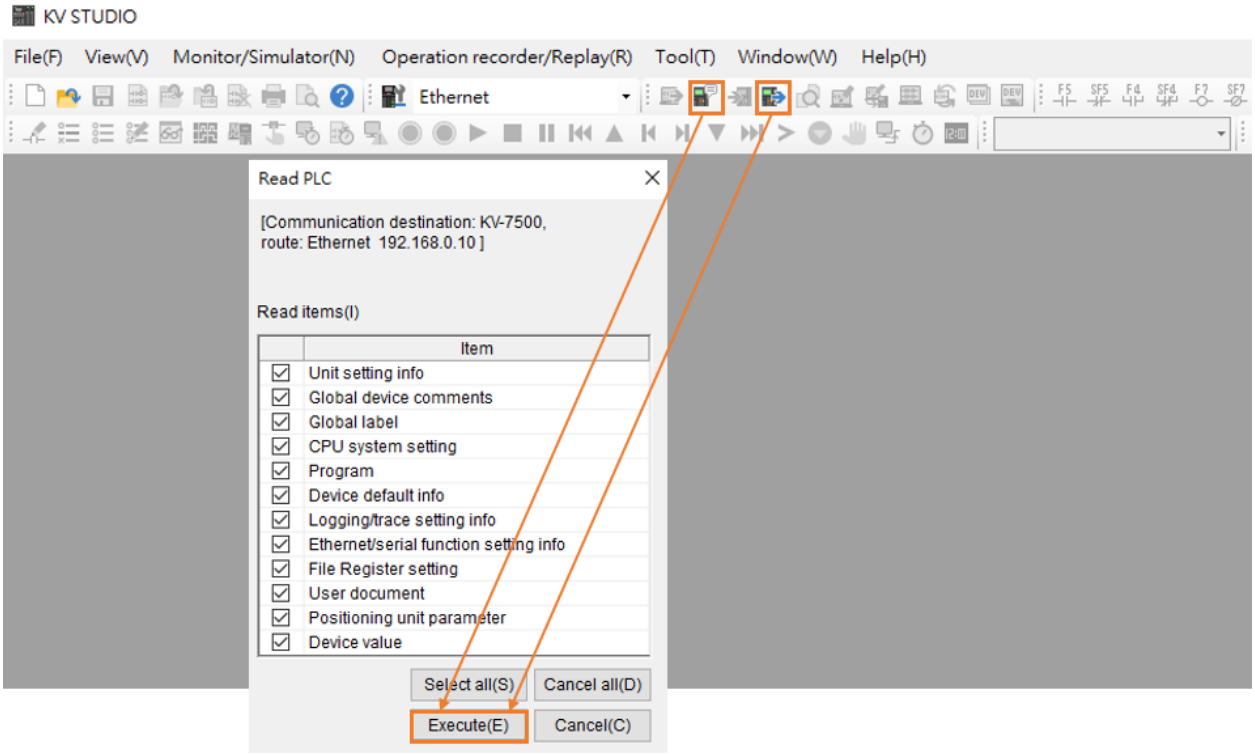

Figure 2.7

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3. Trial run

3.1 Positioning control

1. Check if the KV STUDIO mode is **Monitor**. Click the positioning motion unit set by the parameter and right-click > **Trial run** > **Positioning control** > **Axis**.

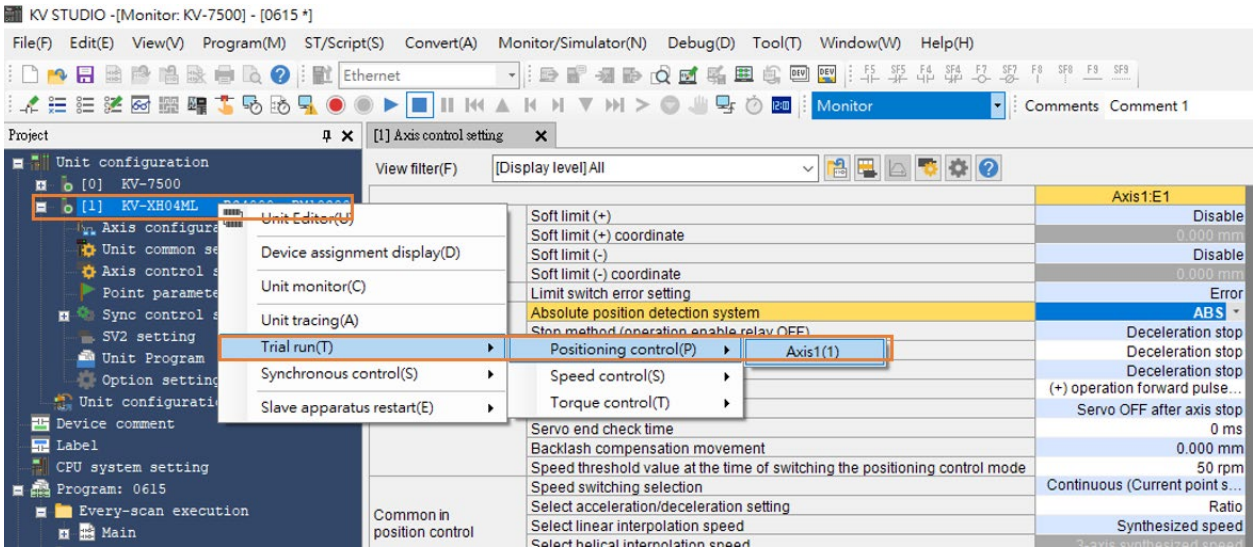

Figure 3.1.1

2. Check if “Axis error” turns to red light. If there is an error, click **Error clear** first; if there is no error, click **Cancel OP. Enable**. When "Operation ready" turns to green light, click **Cancel servo ON** and wait for “Servo ready” light to turn green. The action sequence cannot be reversed. After completing "Servo ready", users can execute JOG movement in forward and reverse directions.

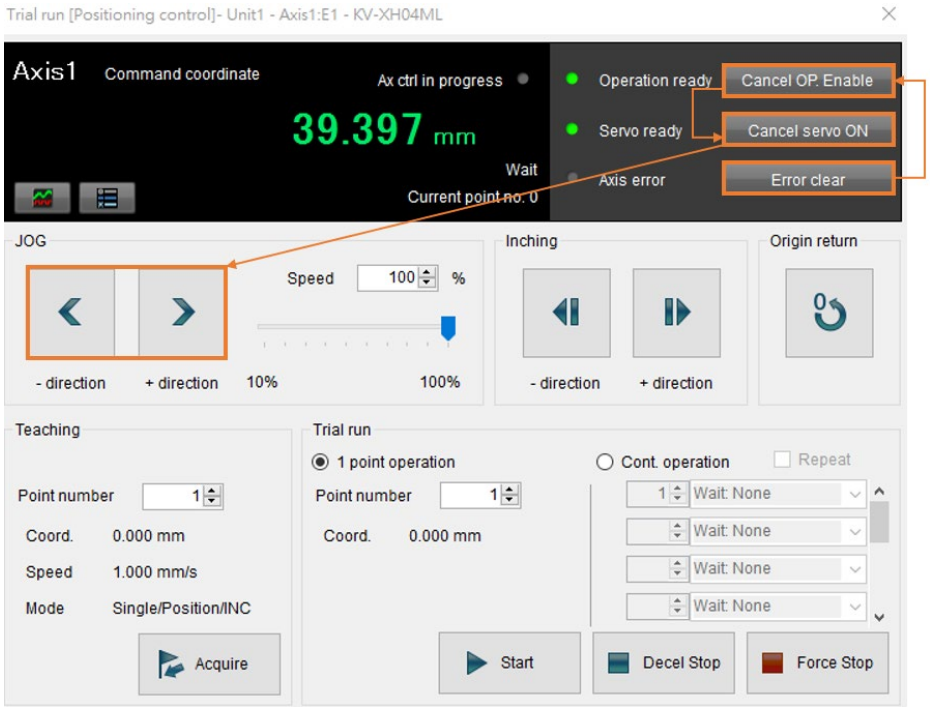

Figure 3.1.2

3. When JOG is moving, users can open **Scope** in **Thunder**, select “7. Motor velocity” to check the speed feedback of the motor, and check if the set speed command is consistent with actual speed feedback of the motor. According to 5.00 mm/s JOG high speed set by the parameter, the corresponding speed is 300 rpm.

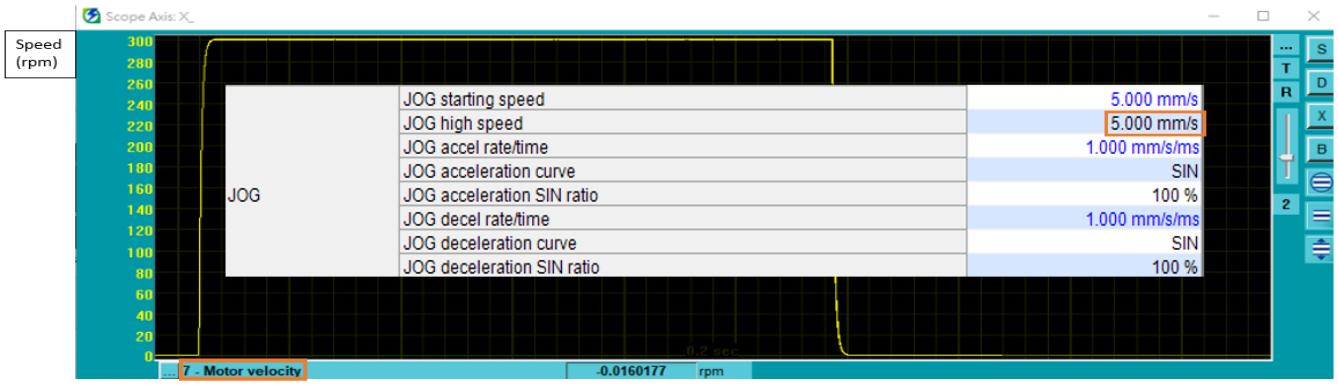

Figure 3.1.3

Note:

(1) If users would like to achieve the position, speed, acceleration, and deceleration set by the positioning motion unit in equal proportion, please set drive parameter electronic gear ratio Pt210 and Pt20E to 1:1.

(2) Thunder 1.9.20.0 or above and drive firmware version 2.8.16 or above support the electronic gear ratio setting other than 1:1.

3.2 Starting speed, acceleration and deceleration rate/time, acceleration curve

1. Complete the parameter setting in Figure 3.2.1 with the above-mentioned setting method.

JOG	JOG starting speed	1.000 mm/s
	JOG high speed	25.000 mm/s
	JOG accel rate/time	0.010 mm/s/ms
	JOG acceleration curve	SIN
	JOG acceleration SIN ratio	100 %
	JOG decel rate/time	0.010 mm/s/ms
	JOG deceleration curve	Linear

Figure 3.2.1

2. Open **Thunder** > **Tools** > **Real-time data collection** and click **Start** to capture the speed command dPosVelCmd.

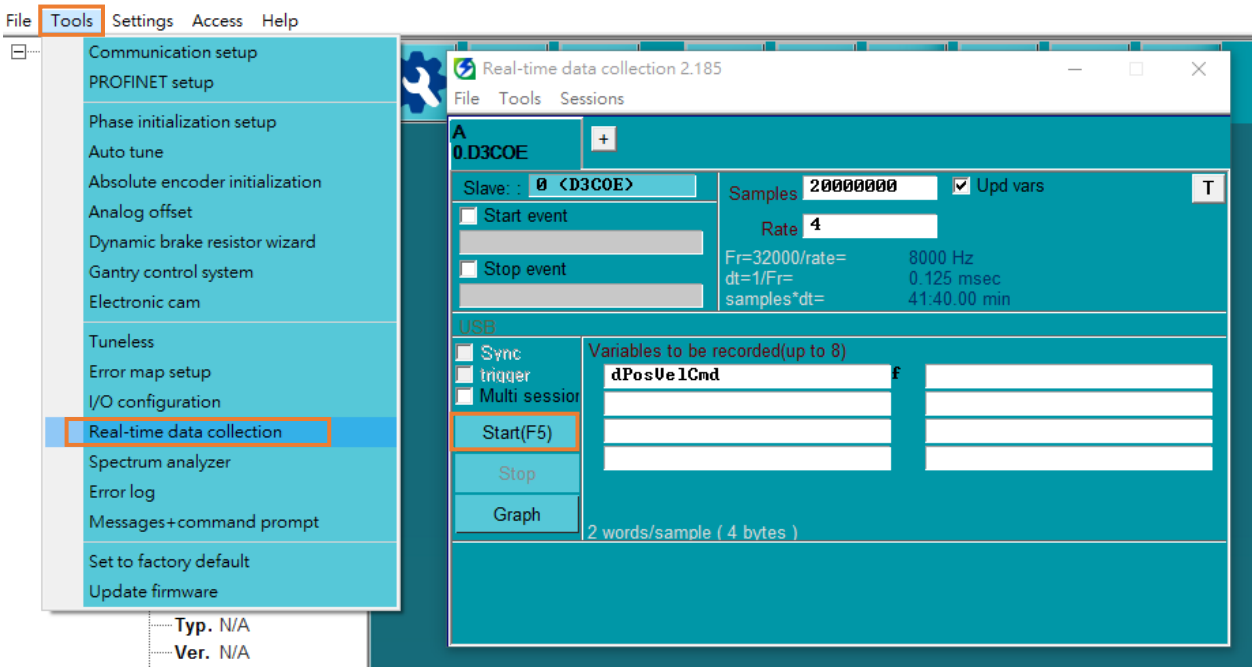

Figure 3.2.2

3. Execute JOG movement in forward direction for a few seconds and release it, wait for the motor to stop.

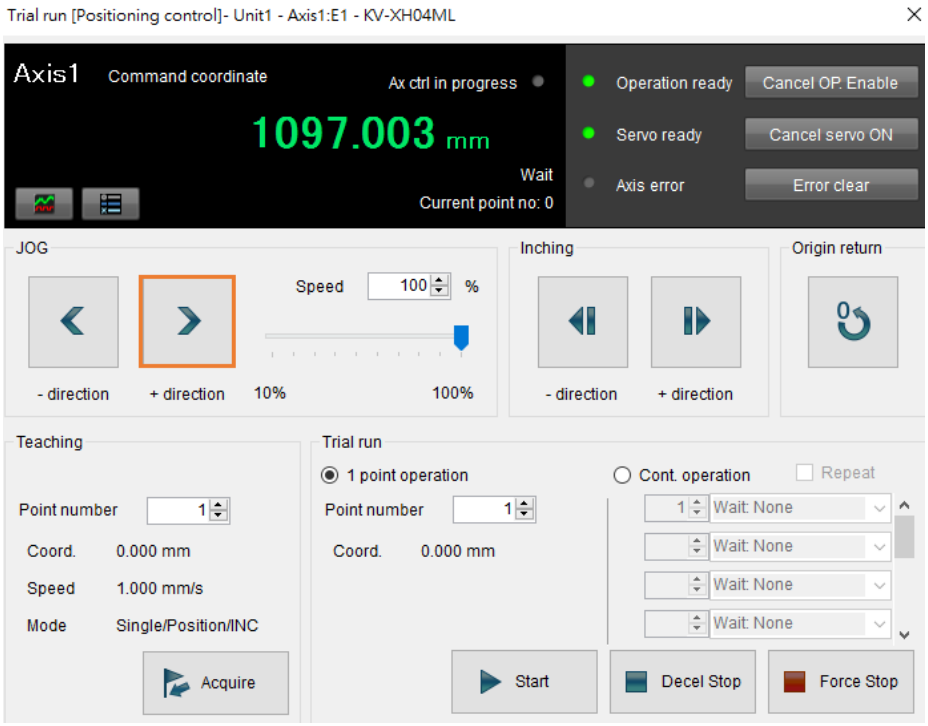

Figure 3.2.3

4. Open **Thunder** > **Tools** > **Real-time data collection**, click **Stop** and then press **Graph** (refer to Figure 3.2.2) to generate Figure 3.2.4.

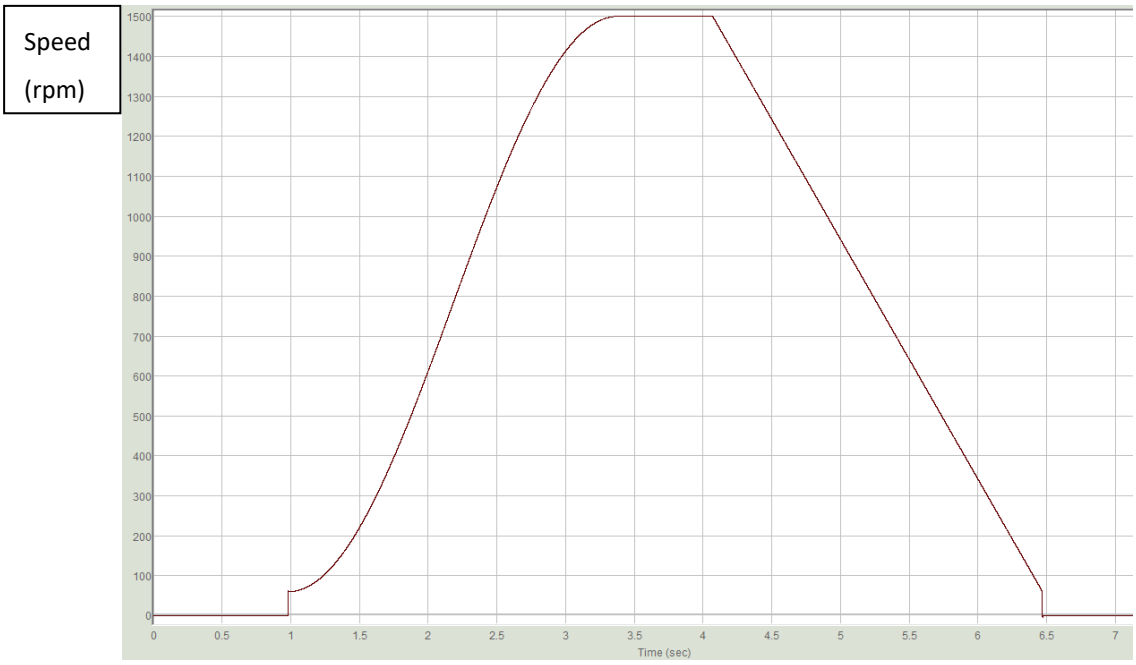

Figure 3.2.4

5. According to the setting in chapter 2 that the resolution for one motor revolution (1mm) is 8388608 pulse/rev, 1.00 mm/s starting speed corresponds to 60 rpm actual speed; 25.00 mm/s JOG high speed corresponds to 1500 rpm actual speed.
   Choose SIN for acceleration curve since the speed command from starting speed to high speed is in a curved shape; choose a straight line for deceleration curve since the speed command from high speed to starting speed is in a straight line.
   The acceleration/deceleration time of 0.010 mm/s/ms corresponds to actual acceleration of 0.6 rpm/ms, indicating that the speed increases by 0.6 rpm every 1 ms.

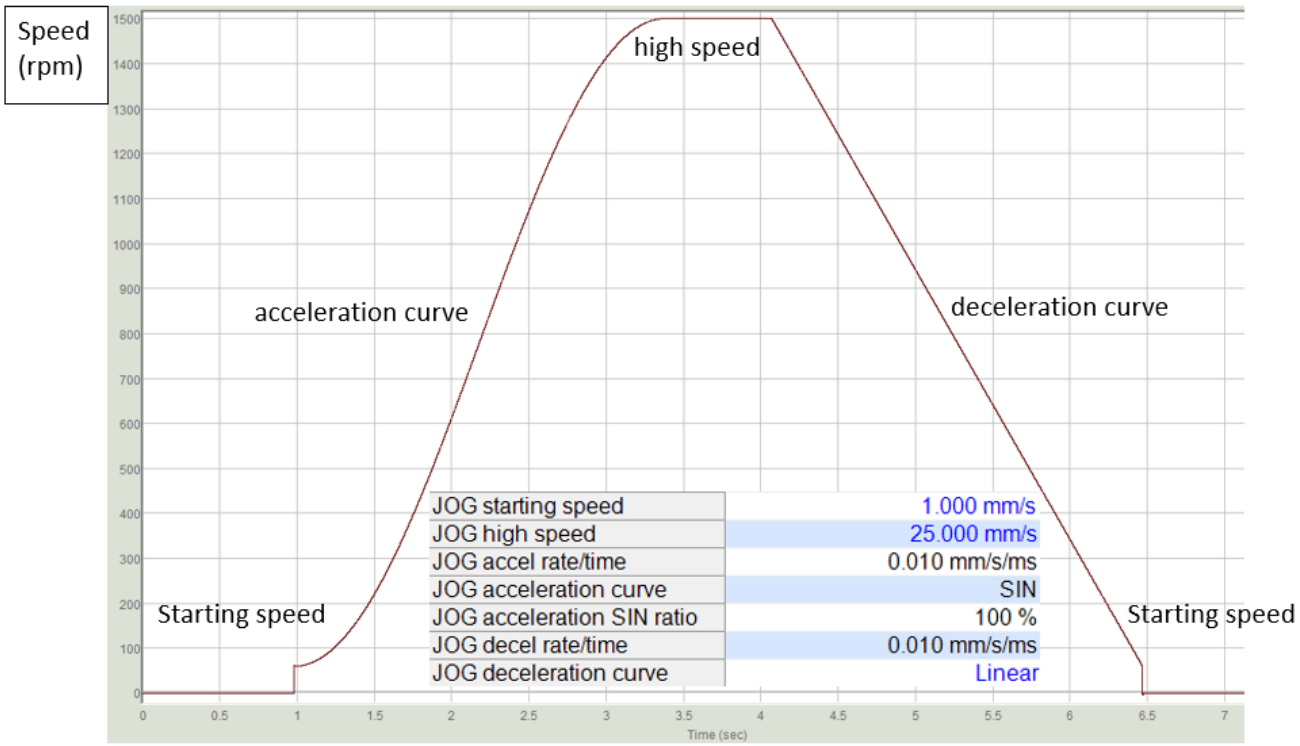

Figure 3.2.5

4. Origin return

4.1 Immediate Z-phase origin return

1. Use the above-mentioned setting method to complete the setting of origin return method and direction in Figure 4.1.1.

Origin return	Origin return method	Immediate Z-phase origin return
	Origin return starting speed	0.000 mm/s
	Origin return creep speed	5.000 mm/s
	Origin return operation speed	5.000 mm/s
	Origin return accel rate/time	1.000 mm/s/ms
	Origin return acceleration curve	SIN
	Origin return acceleration SIN ratio	100 %
	Origin return decel rate/time	1.000 mm/s/ms
	Origin return deceleration curve	SIN
	Origin return deceleration SIN ratio	100 %
	Origin return direction	(-) direction
	Origin coordinate	0.000 mm

Figure 4.1.1

Note:

Immediate Z-phase origin return can be used without any external input signal. This method can be adopted if users cannot input external P-OT, N-OT, DOG, EXT-PROBE1 signals to the drive. If users would like to use external P-OT, N-OT, DOG, EXT-PROBE1 signals for origin return, I/O setting of the drive must be completed first. (For detailed information, please refer to " E Series Servo Drive Thunder Software Operation Manual.")

2. After "Operation ready" and "Servo ready" turn to green light, click **Origin return**. The motor will move in origin return direction and search for the encoder origin (index). It will stop after finding the origin.

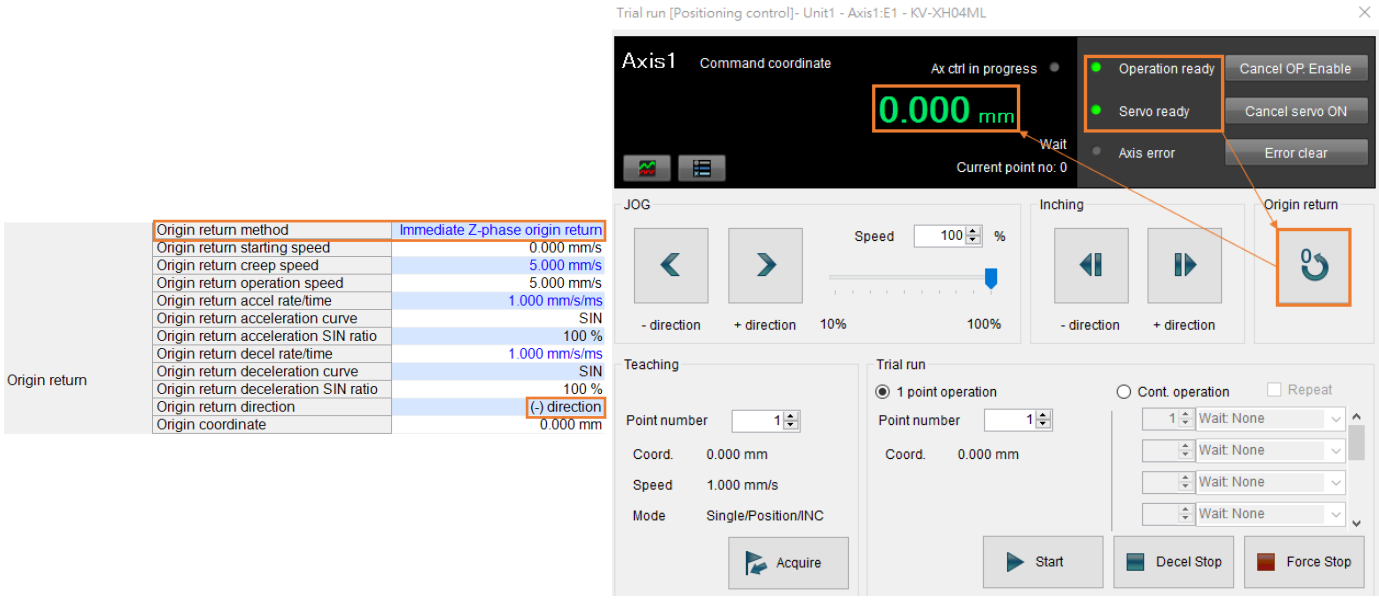

Figure 4.1.2

Note:

When using with an incremental encoder, users need to check if the encoder supports index signal output.

4.2 Limit switch rising edge

After "Operation ready" and "Servo ready" turn to green light, click **Origin return**. When the motor moves in reverse direction, after touching N_OT signal, it will immediately move in forward direction and exit from the signal. After disengagement, the motor will move in reverse direction again and stop until it reaches N_OT. This origin return method only supports in reverse direction.

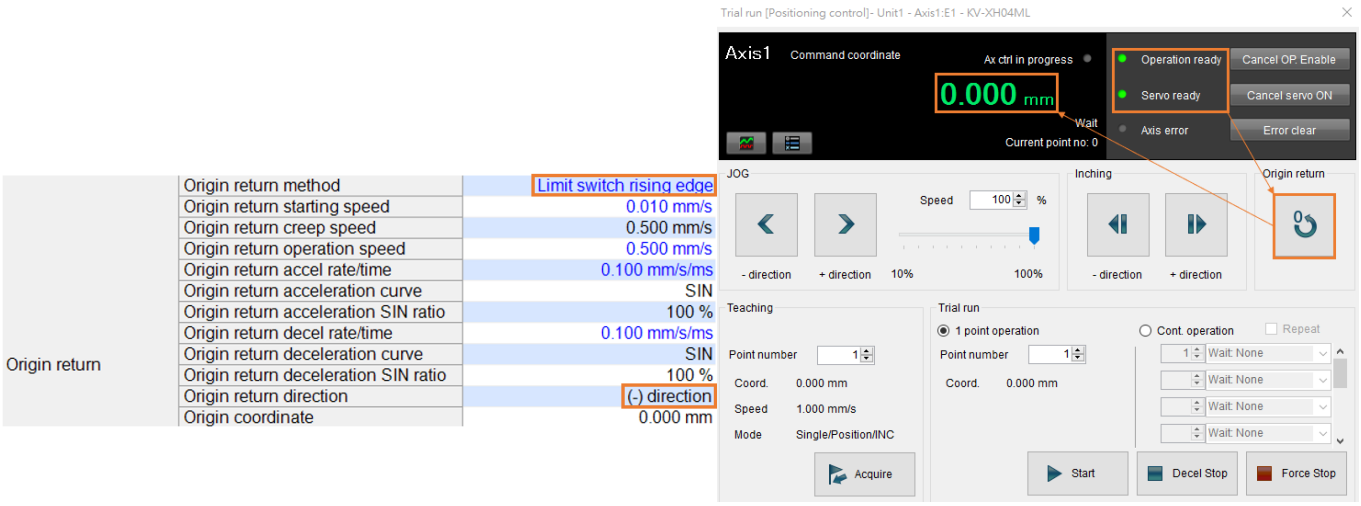

Figure 4.2.1

4.3 Origin sensor and Z-phase

After "Operation ready" and "Servo ready" turn to green light, click **Origin return**. When the motor moves in reverse direction, after touching EXT-PROBE1 signal of origin sensor, it will immediately move in forward direction and exit from the signal. After disengagement, the motor will move in reverse direction again and stop until it reaches EXT-PROBE1 signal of origin sensor.

Origin return	Origin return method	Origin sensor and Z-phase
	Origin return starting speed	0.010 mm/s
	Origin return creep speed	0.500 mm/s
	Origin return operation speed	0.500 mm/s
	Origin return accel rate/time	0.100 mm/s/ms
	Origin return acceleration curve	SIN
	Origin return acceleration SIN ratio	100 %
	Origin return decel rate/time	0.100 mm/s/ms
	Origin return deceleration curve	SIN
	Origin return deceleration SIN ratio	100 %
	Origin return direction	(-) direction
	Origin coordinate	0.000 mm

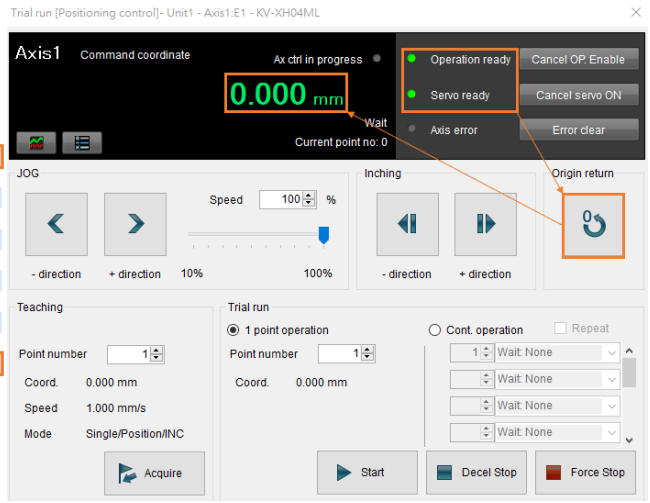

Figure 4.3.1

Supplementary note:

1. The above are the three origin return methods supported by Keyence positioning motion unit. For other methods and detailed information, please refer to chapter 8 in "KV-XH16ML/XH04ML User's Manual."
2. The origin sensor and DOG signal for origin return will correspond to EXT-PROBE1 input signal of the drive.
3. EXT-PROBE1 related functions are only supported by Thunder 1.9.20.0 or above and drive firmware version 2.8.16 or above.